Getting Started with Your
AT-GPIB/TNT and the NI-488.2M™ Software
for HP 9000 Series 700

July 1994 Edition

Part Number 320634A-01

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This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. This equipment has been tested and found to comply with the following two regulatory agencies:

Federal Communications Commission

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class B digital device. A Class B device is distinguishable from a Class A device by the appearance of an FCC ID number located on the Class B device.

Canadian Department of Communications

This device complies with the limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le ministère des communications du Canada.

Instructions to Users

These regulations are designed to provide reasonable protection against interference from the equipment to radio and television reception in residential areas.

There is no guarantee that interference will not occur in a particular installation. However, the chances of interference are much less if the equipment is installed and used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

*   Operate the equipment and the receiver on different branches of your AC electrical system.

*   Move the equipment away from the receiver with which it is interfering.

*   Reorient or relocate the receiver's antenna.

*   Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

Notice to user: Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

If necessary, consult National Instruments or an experienced radio/television technician for additional suggestions. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems.* This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß die AT-GPIB in Übereinstimmung mit den Bestimmungen der Vfg. 1046/1984 funk entstört ist.

Der Detuschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die

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About This Manual

This manual contains instructions to help you install and configure the National Instruments AT-GPIB/TNT interface board and the NI-488.2 multitasking software (NI-488.2M) driver for the HP-UX operating system, version 9.01 and higher. The hardware and software are intended for use on an HP 9000 Series 700 workstation. This manual is meant to be used with the *NI-488.2M Software Reference Manual*.

This manual uses the term *AT-GPIB/TNT* to refer to a National Instruments GPIB board equipped with the TNT4882C ASIC. The term *AT-GPIB* refers to a National Instruments GPIB board equipped with the NAT4882 and Turbo488 ASICs. This manual uses the term *GPIB board* in cases where the material can apply to either board. Both boards are designed for use with the ISA (PC AT) bus, but they can be used in EISA systems, such as the HP 9000 Series 700.

This manual assumes that you are already familiar with the HP 9000 Series 700 workstation and the HP-UX operating system.

Organization of This Manual

This manual is organized as follows:

*   Chapter 1, *Introduction*, explains how to use this manual, lists what you need to get started, and briefly describes the AT-GPIB/TNT and the AT-GPIB interface boards and the NI-488.2M software.

*   Chapter 2, *Hardware Configuration and Installation*, contains instructions to help you configure and install your GPIB board in an HP 9000 Series 700 workstation that has at least one EISA slot.

*   Chapter 3, *Software Installation and Configuration*, contains instructions to help you install and configure your NI-488.2M software in the HP-UX kernel.

*   Chapter 4, *Installation Verification and Troubleshooting*, describes how to verify the software installation and how to troubleshoot problems.

*   Chapter 5, *Using Your NI-488.2M Software*, describes the `ibic` utility and lists some programming considerations.

*   Appendix A, *Hardware Specifications*, describes the physical characteristics of the AT-GPIB/TNT board and the AT-GPIB board and the recommended operating conditions of the boards.

*   Appendix B, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

- The *Glossary* contains an alphabetical list and a description of the terms, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols, that this manual uses.

Conventions Used in This Manual

This manual uses the following conventions.

italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
bold italic	Bold italic text denotes a note, caution, or warning.
`monospace`	Lowercase text in this font denotes text or characters that you literally input from the keyboard. This font also denotes sections of code, programming examples, syntax examples, the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, extensions, and statements and comments taken from program code.
`bold monospace`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen.
`italic monospace`	Italic lowercase text in this font denotes that you must supply the appropriate words or values in the place of these items.
AT-GPIB/TNT	AT-GPIB/TNT refers to a National Instruments GPIB board for the ISA (PC AT) bus equipped with the TNT4882C ASIC.
AT-GPIB	AT-GPIB refers to a National Instruments GPIB board for the ISA (PC AT) bus equipped with the NAT4882 and Turbo488 ASICs.
GPIB board	GPIB board refers generically to either the AT-GPIB/TNT or AT-GPIB board in cases where material can apply to either board.
NI-488.2M	NI-488.2M refers to the NI-488.2M software for HP-UX.
HP-UX	HP-UX refers to the HP-UX operating system on the HP 9000 Series 700 computer.

The *Glossary* lists abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms.

Related Documentation

The following documents contain information that you may find helpful as you read this manual.

- *NI-488.2M Software Reference Manual*

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*

- ANSI/IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands*

- *E/ISA Configuration Guide for HP-UX, HP 9000 Series 700 Computers* (HP part number B2355-90012)

- *HP-UX Driver Development Guide, HP 9000 Series 300/400/700* (HP part number 98577-90013)

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix B, *Customer Communication*, at the end of this manual.

Chapter 1
Introduction

This chapter explains how to use this manual, lists what you need to get started, and briefly describes the AT-GPIB/TNT and the AT-GPIB interface boards and the NI-488.2M software.

How to Use This Manual

Chapter 1	Gather What You Need to Get Started
Chapter 2	Configure the Hardware (Optional) → Install the Hardware
Chapter 3	Install the Software → Need to Change Software Settings? → (Yes) Configure the Software / (No)
Chapter 4	Verify the Installation → Passes? → (No) Troubleshooting / (Yes)
Chapter 5	Run ibic → Review Programming Considerations
NI-488.2M Software Reference Manual	Write Application Program

What You Need to Get Started

❑   AT-GPIB/TNT board

   or

   AT-GPIB board

❑   3.5 in. *NI-488.2M Distribution Disk for the EISA-GPIB/AT-GPIB and HP-UX 9.x*

❑   HP-UX operating system version 9.01 or higher installed on your computer

❑   Super-user privilege

Hardware Description

The AT-GPIB/TNT board, equipped with the TNT4882C ASIC, transforms any
HP 9000 Series 700 workstation into a full-functioning GPIB Talker/Listener/ Controller.
The TNT4882C chip combines the circuitry of the NAT4882 ASIC, the Turbo488
performance-enhancing ASIC, and the GPIB transceivers to create a single-chip
IEEE 488.2 Talker/Listener/Controller interface. The TNT4882C also implements the
HS488 high-speed protocol, which increases the maximum data transfer rate of the
AT-GPIB/TNT to 3.4 Mbytes/s, when used in an EISA computer.

The AT-GPIB board, equipped with NAT4882 and Turbo488 ASICs, also transforms
any HP 9000 Series 700 workstation into a full-functioning IEEE 488.2 Talker/Listener/
Controller. The NAT4882 controller chip is fully compatible with the IEEE 488.2
standard. The Turbo488 performance-enhancing ASIC boosts GPIB read and write
transfers to rates exceeding 1 Mbytes/s.

The AT-GPIB/TNT board is fully compatible with all versions of AT-GPIB
hardware. You can use standard GPIB cables to connect the AT-GPIB/TNT with
up to 14 instruments. You can connect the AT-GPIB board with up to 13 instruments.
If you want to use more than the maximum number of instruments, you can order a bus
extender or expander from National Instruments. Refer to Appendix A, *Hardware
Specifications,* for more information about the GPIB hardware specifications and
operating conditions.

Software Description

The NI-488.2M software and GPIB hardware transform any HP 9000 Series 700
workstation with at least one EISA slot running HP-UX release 9.01 (or higher) into a
GPIB Talker/Listener/Controller with complete communications and bus management
capabilities. The NI-488.2M software includes a driver; an interactive control program;
several utility programs for installing, configuring, and testing the driver; and a
C language interface for use with user-developed applications.

Chapter 2
Hardware Configuration and Installation

This chapter contains instructions to help you configure and install your GPIB board in an HP 9000 Series 700 workstation that has at least one EISA slot.

Warning: *Several components on your GPIB board can be damaged by electrostatic discharge. To avoid such damage when you handle the board, touch the antistatic plastic package to a metal part of your computer chassis before you remove the board from the package.*

Before you install the GPIB board, consider the following:

• You must have super-user privilege.

• You must load the contents of the *NI-488.2M Distribution Disk for the EISA-GPIB/AT-GPIB and HP-UX 9.x* onto the hard drive of your HP workstation. The distribution disk is in `tar` format.

Load the Distribution Disk

1. Log on as super-user (`root`).

2. Create a working directory (for example, `/usr/gpib`) and change to that directory by entering the following commands:

    ```
    mkdir /usr/gpib
    cd /usr/gpib
    ```

3. Insert the NI-488.2M distribution disk and copy the files from the distribution disk to this directory using the `tar` command:

    ```
    tar xvf <floppy device>
    ```

    where `<floppy device>` is the pathname of your floppy disk drive, as represented in the following example:

    ```
    tar xvf /dev/rfloppy/c201d3s0
    ```

Consider Your Hardware Configuration

The GPIB board uses physical switches and jumpers on the board in order to specify what system resources are to be used. Table 2-1 shows the default settings for the switches and jumpers on the GPIB board. These settings are suitable for most HP 9000 Series 700 computer systems. Because of the many different interface boards available for use in the HP 9000 Series 700 workstations, it is not possible to select default settings

that are guaranteed to work in all systems. Conflicts can exist between the default settings of the GPIB board and other boards or devices in your system. With the help of the HP-UX EISA configuration program, you can choose a set of conflict-free settings for the GPIB board to work in your system.

Table 2-1. Hardware Default Settings and Available
Hardware Configurations

GPIB	Hardware Default Settings	Available Hardware Configurations
Base I/O Address (hex)	2C0	100 to 3E0
DMA Channel	5	5, 6, 7, and Not Used
Interrupt Request Line (IRQ)	11	3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, and Not Used

You must run the system EISA configuration program before you physically install or remove a GPIB board. This program uses the EISA configuration files of the GPIB board to help you select appropriate settings for the board so the settings will not conflict with other devices or boards in your system. The EISA configuration file for the AT-GPIB/TNT board is `!NICC30`x`.CFG` and the EISA configuration file for the AT-GPIB is `!NICC00`x`.CFG`, where x is a revision number. Both files are contained in the working directory that you created when you read the *Load the Distribution Disk* section. After the program determines the settings, you must configure the switches and jumpers on the GPIB board to match. To configure the switches and jumpers, refer to the *Configure the Hardware* section, which is located later in this chapter, for details.

Install the GPIB Board

Follow these steps to install the GPIB board:

1. Change to the `/etc/eisa` directory by entering the following command:

    `cd /etc/eisa`

2. Copy the appropriate GPIB board configuration file to the `/etc/eisa` directory from the working directory (`/usr/gpib`). For example, if the working directory contains the files `!NICC304.CFG` and `!NICC005.CFG`, you enter one of the following commands:

    `cp /usr/gpib/!NICC304.CFG . ` (For the AT-GPIB/TNT)

    or

    `cp /usr/gpib/!NICC005.CFG . ` (For the AT-GPIB)

The configuration file should remain in the `/etc/eisa` directory as long as the GPIB board is installed in the system.

3. Run the system `EISA` configuration program by entering the following command:

   `/etc/eisa_config`

   The current board configuration is displayed. Board slots are numbered starting with 1. Slot 0 is reserved for the system board.

4. Enter the following command at the `EISA:` prompt in order to add the GPIB board to an unused slot *n*:

   `add NICCxxx n`

   where `NICCxxx` is a portion of the board configuration file name that you copied in step 2. For example, `NICC304`.

   If you encounter problems while running the `eisa_config` program, consult the *E/ISA Configuration Guide for HP-UX, HP 9000 Series 700 Computers* manual for additional information.

5. After you have successfully added the GPIB board, exit the program by entering `q`, then enter `s` to save the change to the configuration file of the system.

   Before the program exits, it displays the board that you added during the `eisa_config` session. For a summary of the new configuration, including its required settings, refer to the `/etc/eisa/config.log` file. If these settings are different from the factory default settings of the GPIB board, you must change the switches and/or jumpers to match the new settings. Refer to the *Configure the Hardware* section for more information.

   Note: *The GPIB board uses negative logic; the OFF position of the switch represents a logic one and the ON position represents a logic zero. As a result, some of the screens in your EISA configuration program or in the* `config.log` *file might show a pattern of ones and zeros that is exactly opposite of the correct way to set your switch. The screen will show a picture of the switch, a pattern of ones and zeros, and a pattern of ONs and OFFs. The pattern of ONs and OFFs shown on the screen is correct. Set your switches to match these ONs and OFFs. Do not use the picture of the switch or the pattern of ones and zeros on the screen as your guide for setting the switches.*

6. Enter the following command to halt the system, then power off the system:

   `/etc/shutdown -h`

7. Insert the GPIB board into the `EISA` slot *n*.

> **Note:** *Some HP 9000 Series 700 machines support one or more EISA slots as standard equipment, while other HP 9000 Series 700 machines support EISA only as an installable option. The AT-GPIB/TNT board is an ISA-compatible card. Consequently, you may need an ISA guide rail to correctly install the AT-GPIB/TNT board into the selected EISA slot. For detailed installation instructions and warnings about your particular EISA configuration, refer to the manuals that came with your system.*

8. Power on the system.

Configure the Hardware (Optional)

Follow the instructions in this section to change the hardware default settings of the GPIB board.

The default settings for the switches and jumpers on the GPIB board are as follows:

- Base I/O Address (hex): 2C0

- DMA Channel: 5

- Interrupt Line (IRQ): 11

Refer to the following figures to locate the switches and jumpers on your GPIB board.

Figure 2-1 shows the location of the configuration jumpers and switches on the AT-GPIB/TNT board.
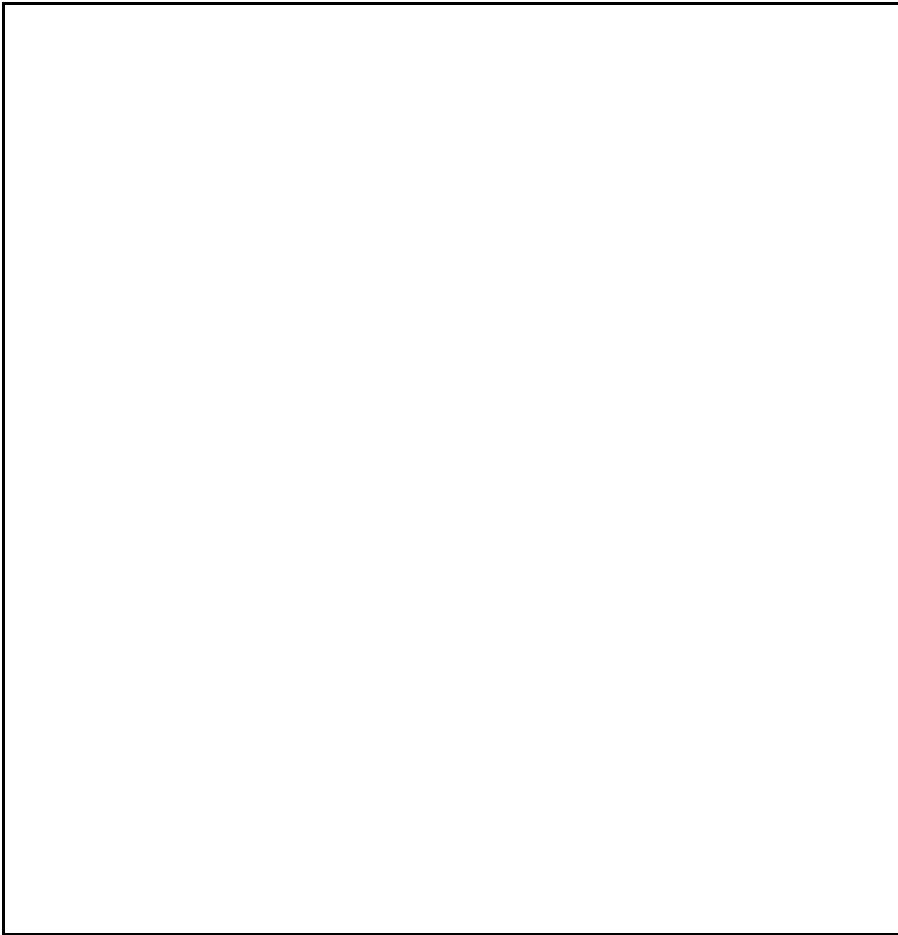
Figure 2-1. AT-GPIB/TNT Parts Locator Diagram

Figure 2-2 shows the location of the configuration jumpers and switches on the AT-GPIB board.
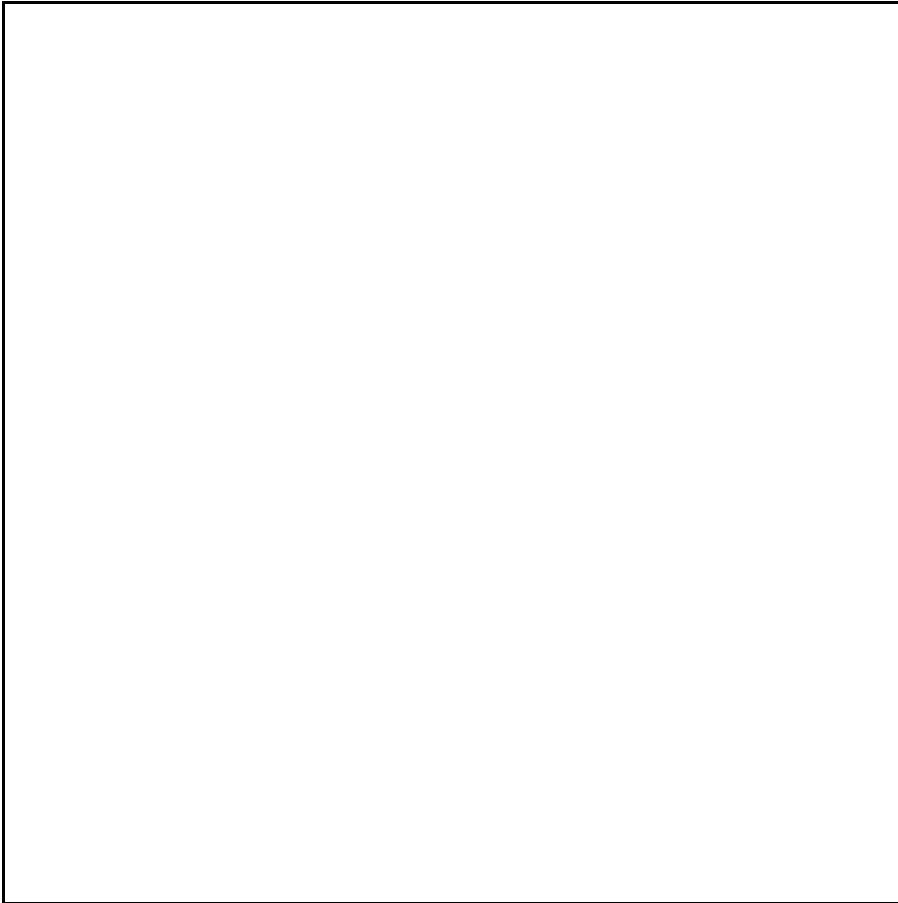
Figure 2-2. AT-GPIB Parts Locator Diagram

Selecting the Base I/O Address

By default, the GPIB board is configured to use base I/O address 2C0 hex. With this setting, the board uses the I/O address space 2C0 hex through 2DF hex.

If, for some reason, you must change the base I/O address of the board to something other than 2C0 hex, run the system configuration program, `eisa_config`, and reconfigure the base I/O address of the board in the system configuration.

Note: ***If you are making this change because a previous run of*** `eisa_config`
            prompted you to reconfigure the base I/O address of the board to avoid
            conflicts, you do not need to run `eisa_config` ***again.***

1.   Enter the following command at the `EISA:` prompt to obtain a list of the base I/O
     address choices of the GPIB board:

     `show board` *slotnum*

     where *slotnum* should be replaced by the actual slot number that your board
     occupies.

2.   Enter the following command at the `EISA:` prompt:

     `change` *slotnum* `F1` *choicenum*

     where *slotnum* should be replaced by the actual slot number that your board
     occupies, `F1` is the function number of the function `AT-GPIB/TNT Base I/O`
     `Address`, and *choicenum* should be replaced with the actual choice number of
     the preferred base I/O address (for example, CH1 is the choice number for 2C0 hex).

For details on how to use the `change` and `show board` commands in `eisa_config`,
refer to Chapter 3, *Configuring E/ISA Boards Interactively*, in the *E/ISA Configuration
Guide for HP-UX, HP 9000 Series 700 Computers*.

Record the new setting on the *GPIB Board Hardware and Software Configuration Form*
in Appendix B, *Customer Communication*, and reconfigure the GPIB board as described
in the following paragraphs.

The switches at position SW1 on your AT-GPIB/TNT board and at U25 on your
AT-GPIB board determine the base I/O address (refer to the appropriate parts locator
diagram, Figure 2-1 or 2-2). Each switch in SW1 or U25 corresponds to one of the EISA
bus address lines A9 through A5. The top switch (1) corresponds to address line A9, the
next switch from the top (2) corresponds to address line A8, and so on. The five least
significant bits of the address (A4 through A0) are used by the GPIB board to select the
appropriate GPIB adapter register and cannot be changed; therefore, bits A4 through A0
are always 00000 (binary) when you determine the base I/O address.

Press down on the side marked 1 to select a binary value of 1 for the corresponding
address bit. Press down on the side marked 0 to select a binary value of 0 for the
corresponding address bit (refer to Figure 2-3).

Figure 2-3 is an example of the switch settings and the corresponding address bit. The address selection shows how the base I/O address was calculated from the switch positions.
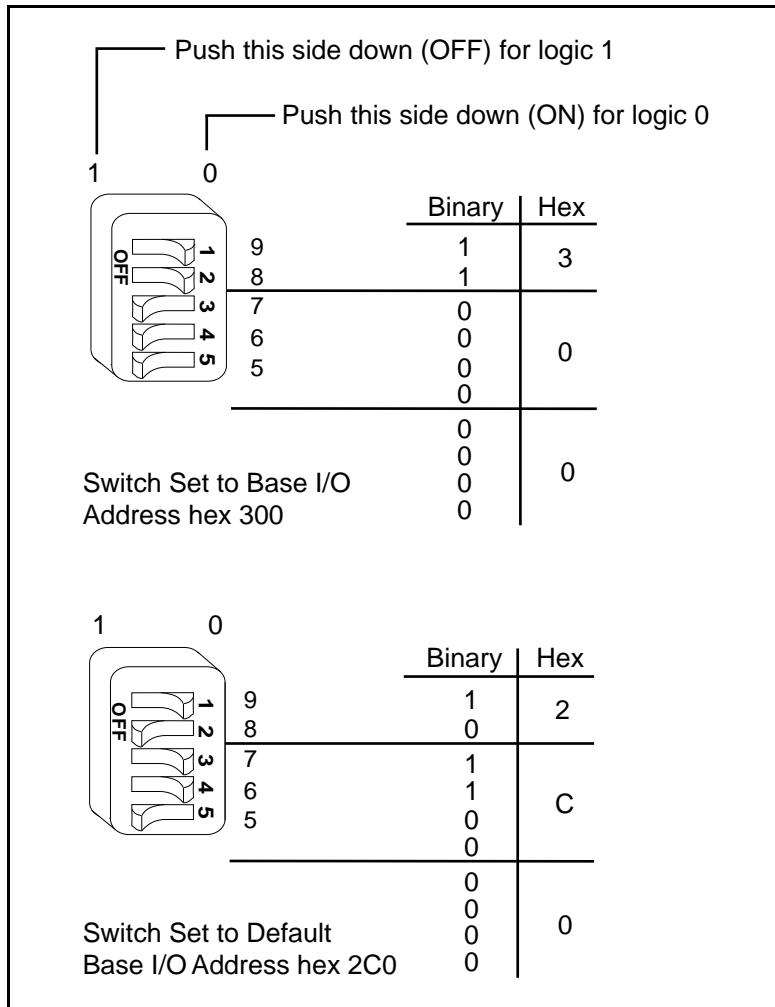
Figure 2-3. Base I/O Address Switch Setting

To change the base I/O address, press each switch to the desired position, then check each switch to make sure it is pressed down completely. Table 2-2 lists the possible switch settings, the corresponding base I/O address, and the I/O address space used for that setting.

Table 2-2. Possible Base I/O Address Switch Settings

Switch Setting					Base I/O Address (hex)	I/O Address Space Used (hex)
A9	A8	A7	A6	A5		
0	1	0	0	0	100	100 to 11F
0	1	0	0	1	120	120 to 13F
0	1	0	1	0	140	140 to 15F
0	1	0	1	1	160	160 to 17F
0	1	1	0	0	180	180 to 19F
0	1	1	0	1	1A0	1A0 to 1BF
0	1	1	1	0	1C0	1C0 to 1DF
0	1	1	1	1	1E0	1E0 to 1FF
1	0	0	0	0	200	200 to 21F
1	0	0	0	1	220	220 to 23F
1	0	0	1	0	240	240 to 25F
1	0	0	1	1	260	260 to 27F
1	0	1	0	0	280	280 to 29F
1	0	1	0	1	2A0	2A0 to 2BF
1	0	1	1	0	2C0	2C0 to 2DF
1	0	1	1	1	2E0	2E0 to 2FF
1	1	0	0	0	300	300 to 31F
1	1	0	0	1	320	320 to 33F
1	1	0	1	0	340	340 to 35F
1	1	0	1	1	360	360 to 37F
1	1	1	0	0	380	380 to 39F
1	1	1	0	1	3A0	3A0 to 3BF
1	1	1	1	0	3C0	3C0 to 3DF
1	1	1	1	1	3E0	3E0 to 3FF

Selecting the Interrupt Request Line

The GPIB board can use any of the following interrupt request lines (IRQs): IRQ3, IRQ4, IRQ5, IRQ6, IRQ7, IRQ9, IRQ10, IRQ11, IRQ12, IRQ14, and IRQ15. By default, the GPIB board is configured to use IRQ11.

If, for some reason, you must change the board IRQ to something other than IRQ11, run the system configuration program, `eisa_config`, and reconfigure the board IRQ in the system configuration.

Note: ***If you are making this change because a previous run of*** `eisa_config` ***prompted you to reconfigure the IRQ of the board to avoid conflicts, you do not need to run*** `eisa_config` ***again.***

1. Enter the following command at the `EISA:` prompt to obtain a list of the IRQ choices of the GPIB board:

   `show board` *`slotnum`*

   where *`slotnum`* should be replaced by the actual slot number that your board occupies.

2. Enter the following command at the `EISA:` prompt:

   `change` *`slotnum`* `F3` *`choicenum`*

   where *`slotnum`* should be replaced by the actual slot number that your board occupies, `F3` is the function number of the function `AT-GPIB/TNT Interrupt Request Level`, and *`choicenum`* should be replaced with the actual choice number of the preferred IRQ (for example, CH1 is the choice number for IRQ11).

For details on how to use the `change` and `show board` commands in `eisa_config`, refer to Chapter 3, *Configuring E/ISA Boards Interactively*, in the *E/ISA Configuration Guide for HP-UX, HP 9000 Series 700 Computers*.

Record the new setting of the IRQ on the *GPIB Board Hardware and Software Configuration Form* in Appendix B, *Customer Communication*, and reconfigure the GPIB board as described in the following paragraphs.

There are two IRQ selection jumpers on the GPIB board (refer to the appropriate parts locator diagram, Figure 2-1 or Figure 2-2). One IRQ selection jumper, which is a combination jumper, is located at position W1. This jumper selects the high IRQ levels (10, 11, 12, 14, and 15) and the DMA channels. The other IRQ selection jumper is located at position W2. This jumper selects the low IRQ levels (3, 4, 5, 6, 7, and 9). You should select only one of the high IRQ or low IRQ levels.

To select an IRQ, place the jumper on the appropriate pins. Figure 2-4 shows the hardware default setting of the IRQ for the AT-GPIB/TNT board.
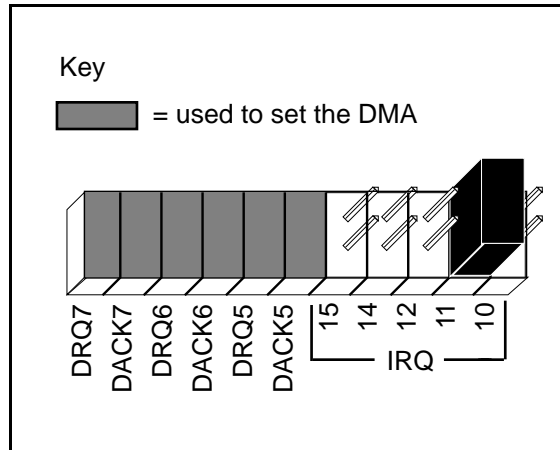
Figure 2-4. IRQ Jumper Setting for IRQ11 (Default Setting)

Figure 2-5 shows the setting for IRQ5.
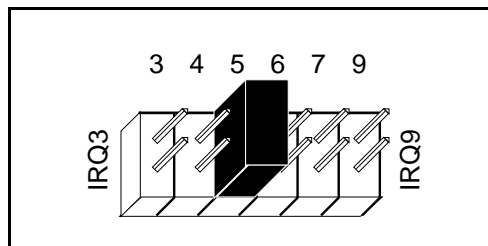
Figure 2-5. Interrupt Jumper Setting for IRQ5

To change to another interrupt line, remove the jumper from its stored position and place it on the new posts.

Selecting the DMA Channel

Direct memory access (DMA) refers to data transfers between devices, such as the GPIB board and computer memory, without the active participation of the CPU. Your GPIB hardware and the NI-488.2M software are designed to perform DMA. In most cases, data transfers that use DMA are significantly faster than programmed I/O transfers, which use more CPU time.

The GPIB board supports DMA channels 5, 6, and 7. DMA can also be disabled for programmed I/O operation. The GPIB board is set at the factory to use DMA channel 5.

If, for some reason, you must change the DMA channel of the board to something other than 5, run the system configuration program, `eisa_config`, and reconfigure the DMA channel of the board in the system configuration.

Note: *If you are making this change because a previous run of* `eisa_config` *prompted you to reconfigure the DMA channel of the board to avoid conflicts, you do not need to run* `eisa_config` *again.*

1. Enter the following command at the `EISA:` prompt to obtain a list of the DMA channel choices of the GPIB board:

   `show board slotnum`

   where `slotnum` should be replaced by the actual slot number that your board occupies.

2. Enter the following command at the `EISA:` prompt:

   `change slotnum F2 choicenum`

   where `slotnum` should be replaced by the actual slot number that your board occupies, `F2` is the function number of the function `AT-GPIB/TNT DMA Channel`, and `choicenum` should be replaced with the actual choice number of the preferred DMA channel (for example, CH1 is the choice number for DMA channel 5).

For details on how to use the `change` and `show board` commands in `eisa_config`, refer to Chapter 3, *Configuring E/ISA Boards Interactively*, in the *E/ISA Configuration Guide for HP-UX, HP 9000 Series 700 Computers*.

Record the new setting of the DMA channel on the *GPIB Board Hardware and Software Configuration Form* in Appendix B, *Customer Communication*, and reconfigure the GPIB board as described in the following paragraphs.

The DMA channel that is used is determined by a jumper located at position W1 (refer to the appropriate parts locator diagram, Figure 2-1 or Figure 2-2). Each DMA channel consists of two signal lines, as shown in Table 2-3.

Table 2-3. DMA Channels for the AT-GPIB/TNT Board

DMA Channel	Signal Lines	
	DMA Acknowledge	DMA Request
5	DACK5	DRQ5
6	DACK6	DRQ6
7	DACK7	DRQ7
NONE	-	-

You must position two jumpers to select a DMA channel. One jumper selects the DMA Request line (DRQ), and the other jumper selects the DMA Acknowledge line (DACK). You must move these two jumpers as a pair, and for proper operation, the DMA Acknowledge and DMA Request lines that you select must have the same numeric suffix.

Figure 2-6 shows the default DMA channel setting (DMA channel 5) of the board.
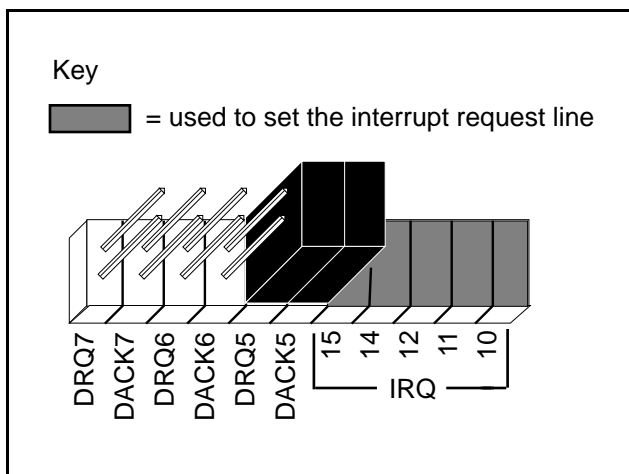
Figure 2-6. DMA Channel Jumper Setting for DMA Channel 5 (Default Setting)

If you do not want to use DMA for GPIB transfers (in which case the GPIB board will use programmed I/O GPIB transfers), you can optionally disconnect the GPIB board from the DMA lines. If you disabled DMA in `eisa_config`, you are not required to change the jumpers on the board. However, you might want to move the jumpers, as shown in Figure 2-7, as a reminder that you are not using DMA.
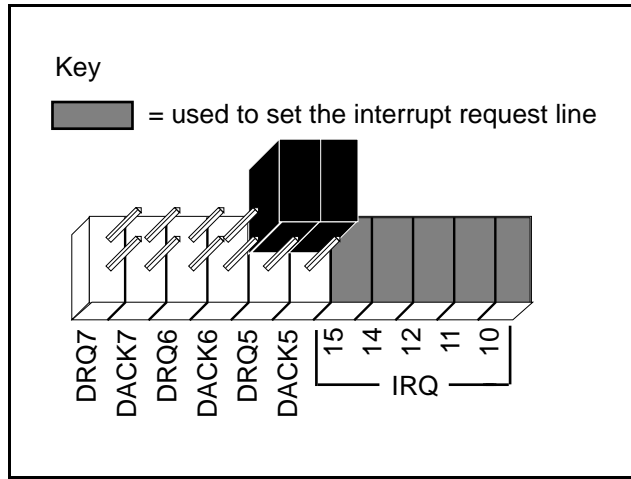
Figure 2-7. DMA Jumper Setting in the Storage Position for No DMA Channel

Setting the Shield Ground Configuration

The GPIB board is set at the factory with the jumper in place to connect the logic ground of the GPIB board to its shield ground. This configuration minimizes the EMI emitted from an HP 9000 Series 700 workstation equipped with the GPIB board. However, if your application requires that logic ground be disconnected from shield ground, remove the jumper (W3 for the AT-GPIB/TNT board and W1 for the AT-GPIB board) and place it across only one of the jumper pins. Figure 2-8 shows jumper settings for logic ground that is connected and disconnected from shield ground.
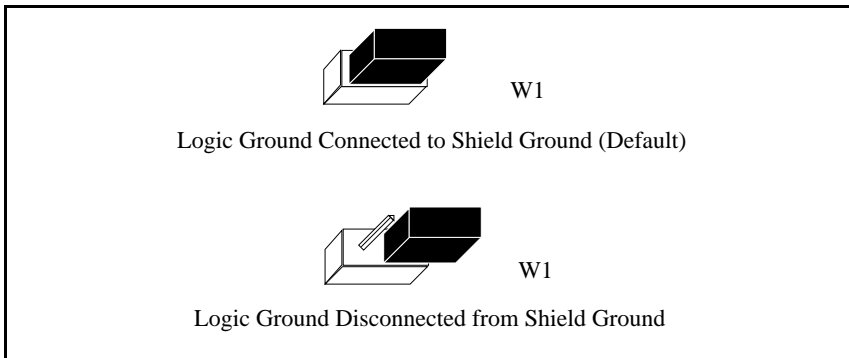
Figure 2-8. Ground Configuration Jumper Settings

Caution:　*The GPIB board was tested for compliance with FCC standards with the shield ground connected to logic ground. Removing the jumper may cause EMI emissions to exceed any or all of the applicable standards.*

If you change the board's shield ground from its default position, record the new setting on the *GPIB Board Hardware and Software Configuration Form* in Appendix B, *Customer Communication*.

Remove the Board (Optional)

Follow these steps to remove a currently installed GPIB board:

1.　Change to the /etc/eisa directory by entering the following command:

　　cd /etc/eisa

2.　Run the system EISA configuration program by entering the following command:

　　/etc/eisa_config

3.　Type the following command at the EISA: prompt in order to remove the GPIB board installed at slot *n*:

　　remove *n*

4.　Exit the program by entering q, then enter s to save the change to the system configuration file.

5. Shut down the system with the following command, then power off the system:

    ```
    /etc/shutdown -h
    ```

6. Remove the board.

    Note: *For detailed installation instructions and warnings about your particular EISA configuration, refer to the manuals that came with your system.*

7. Power on the system.

Chapter 3
Software Installation and Configuration

This chapter contains instructions to help you install and configure your NI-488.2M software in the HP-UX kernel.

Prepare to Install the Software

Before you install the software, consider the following:

• You must have super-user privilege.

• The contents of the NI-488.2M distribution disk should already have been loaded into a working directory on your hard drive (for example, `/usr/gpib`) during hardware installation. See Chapter 2, *Hardware Configuration and Installation*.

The NI-488.2M working directory should contain the following files:

• `!NICC00x.CFG` is the AT-GPIB board configuration file.

• `!NICC30x.CFG` is the AT-GPIB/TNT board configuration file.

• `!NICC50x.CFG` is the EISA-GPIB board configuration file.

• `cib.c` is the C language interface library.

• `cib.h` is the private include file for `cib.c`.

• `ib_hpux.o` is the NI-488.2M driver for the GPIB board.

• `ibconf` is the software configuration utility.

• `ibic` is the interface bus interactive control utility.

• `ibtsta` is the software installation test, part A.

• `ibtstb` is the software installation test, part B.

• `instgpib` is the install script for the driver.

• `ugpib.h` is the include file for user programs.

Note: *The NI-488.2M driver supports the National Instruments EISA-GPIB interface board as well as the AT-GPIB. The EISA-GPIB configuration file (`!NICC50x.CFG`), which is included in the software distribution, is unused for this installation.*

Install the NI-488.2M Software

You can install the NI-488.2M software either automatically or manually, as described in the following sections.

Automatic Installation

To automatically install the NI-488.2M software, go to your working directory (`/usr/gpib`) and enter the following command:

```
./instgpib
```

The program prompts you for the information it needs to install the driver and utilities.

If the automatic installation fails, `instgpib` displays the error encountered during the installation.

Manual Installation

To manually install the NI-488.2M software, go to your working directory (`/usr/gpib`) and complete the following steps:

1. Copy the file `ugpib.h` to `/usr/include/sys` by entering the following command:

   ```
   cp ugpib.h /usr/include/sys
   ```

2. Copy the files `ibic`, `ibconf`, `ibtsta`, and `ibtstb` to a directory in the command search path (for example, `/usr/bin`) by entering the following commands:

   ```
   cp ibic /usr/bin
   cp ibconf /usr/bin
   cp ibtsta /usr/bin
   cp ibtstb /usr/bin
   ```

3. Install the C library by compiling the file `cib.c` and converting its object file `cib.o` into a library. This procedure is necessary if you are compiling your application with the `-lgpib` option, as described in Chapter 5, *Using Your NI-488.2M Software*. To compile the file `cib.c` and create a C language library, enter the following commands:

   ```
   cc -c cib.c
   ar rv /usr/lib/libgpib.a cib.o
   ```

Alternatively, you can add `cib.o` to an existing library or simply include `cib.o` during the link phase of each compile operation. See Chapter 5 for more information.

4. Change to the `/etc/conf` directory by entering the following command:

   ```
   cd /etc/conf
   ```

5. Make a backup copy of your current system configuration description file (for example, `/etc/conf/dfile`) by entering the following command:

   ```
   cp dfile dfile.old
   ```

6. Add the NI-488.2M driver to the `dfile` file by editing `/etc/conf/dfile`. Find the line containing `* Drivers and Subsystems`. Below this line, add the name of the NI-488.2M driver `ib`.

7. Make a backup copy of the `/etc/master` file, which lists all possible device drivers, by entering the following command:

   ```
   cp /etc/master /etc/master.old
   ```

8. Include the NI-488.2M driver in the master file by editing `/etc/master`. Find the line shown below:

   ```
   **Reserved for Third Party and User Drivers.
   ```

   Below this line, you should find one or more lines in the following six-field format:

   ```
   **     ----      -       -1     N
   ```

   In the above line, N is a number not equal to -1. Choose one of those lines and replace its first four fields with the following:

   ```
   ib    ib    1    1F8
   ```

   so that the line reads as

   ```
   ib    ib    1    1F8 -1    N
   ```

   The value for N is the major number of the GPIB board. You should make a note of the value of N for later use.

9. Generate the files used to create a new kernel containing the NI-488.2M driver by entering the following command:

   ```
   /etc/config dfile
   ```

   The files generated are `config.mk`, a make file that you use to generate a new HP-UX kernel, and `conf.c`, a C file that links in the NI-488.2M driver.

10. Add the NI-488.2M driver to the HP-UX kernel by copying it into a standard library:

    ```
    ar rv libusrdrv.a /usr/gpib/ib_hpux.o
    ```

11. Build a new kernel by entering the following command:

    ```
    make -f config.mk
    ```

    This builds a new HP-UX kernel, named `hp-ux`, in your current directory, which should be `/etc/conf`. This new kernel contains the NI-488.2M driver.

12. Install the new kernel by entering the following commands in order:

    ```
    cp /hp-ux /SYSBCKUP
    cp ./hp-ux /hp-ux
    ```

    The backup of the previous kernel is saved as `SYSBCKUP` under the root directory (/).

13. Create the device node for the NI-488.2M driver by entering the following commands in order:

    ```
    cd /dev
    mknod gpib c N 50
    ```

    where *N*, which you recorded in step 8, is the major number of the GPIB board.

14. Reboot the system by entering the following command:

    ```
    sync;sync;/etc/reboot
    ```

Configure the Software with ibconf

If you installed the software manually, you must run the software configuration utility `ibconf` (you must have super-user privilege). You run `ibconf` because it creates the remaining device nodes that the driver needs. If you used the automatic installation procedure, running `ibconf` is optional.

`ibconf` is a screen-oriented utility that you can use to inspect and modify the default software parameters. `ibconf` is largely self-explanatory, with help screens to explain commands and options. For more information on using `ibconf`, refer to Chapter 2, *Installation and Configuration of NI-488.2M Software*, in the *NI-488.2M Software Reference Manual*.

Running ibconf

To create the device nodes and/or change the GPIB parameters, simply type `ibconf` at the command prompt.

The synopsis of the command is as follows:

```
ibconf [file]
```

where *file* can be any HP-UX kernel file with the NI-488.2M driver installed. The default HP-UX kernel file is `/hp-ux.`

If you have given your HP-UX kernel file a name other than `/hp-ux`, use the file option to give the whole path name of the HP-UX kernel. For example, if the kernel name is `/hp-ux.new`, enter the following command:

```
ibconf /hp-ux.new
```

Exiting ibconf

Save the current configuration by typing `y` before you exit `ibconf.` At this time, even if you did not make any changes to the configuration settings, you should still type a `y` to have `ibconf` create the special device files `gpib*` and `dev*` in the `/dev` directory.

If you did not make any changes to the configuration settings or if you only renamed devices, you do *not* have to restart the system. However, if you made any changes to the configuration settings, you must restart the system to run on the new kernel. Restart the system by entering the following command:

```
sync;sync;/etc/reboot
```

Remove the NI-488.2M Driver (Optional)

You may want to remove the NI-488.2M driver at some time. You must remove the driver manually.

To manually remove the NI-488.2M driver, follow a procedure that is similar to the procedure you would use to manually install the driver (see the *Install the NI-488.2M Software* section, which is located earlier in this chapter). The only difference is that instead of adding the NI-488.2M driver information to the current system configuration description file (`/etc/conf/dfile`) and `/etc/master`, you must remove the driver information from those files.

Complete the following steps to remove the NI-488.2M driver from the kernel:

1. Change to the `/etc/conf` directory by entering the following command:

    ```
    cd /etc/conf
    ```

2. Edit your current system configuration description file (for example,
    `/etc/conf/dfile`) to remove the name of the NI-488.2M driver `ib`.

3. Edit file `/etc/master` and remove the following line:

    ```
    ib     ib     1      1F8    -1     N
    ```

    where *N* is the major number you chose for the GPIB board.

4. Generate the new files used to create a new kernel not containing the NI-488.2M
    driver by entering the following command:

    ```
    /etc/config dfile
    ```

5. Build the new kernel by entering the following command:

    ```
    make -f config.mk
    ```

    This builds a new HP-UX kernel, named `hp-ux`, in your current working directory,
    which should be `/etc/conf`. The new kernel does not contain the NI-488.2M
    driver.

6. Install the new kernel by entering the following commands in order:

    ```
    cp /hp-ux /SYSBCKUP
    cp ./hp-ux /hp-ux
    ```

    The backup of the previous kernel is saved as `SYSBCKUP` under the root
    directory (/).

7. Reboot the system to use the new kernel by entering the following command:

    ```
    sync;sync;/etc/reboot
    ```

Chapter 4
Installation Verification and Troubleshooting

This chapter describes how to verify the software installation and how to troubleshoot problems.

Run the Software Installation Test Program

The software installation test has two parts: `ibtsta` and `ibtstb`.

- `ibtsta` checks for a correct node `/dev/gpib0` and correct access to the device driver.

- `ibtstb` checks for correct DMA and interrupt operation. `ibtstb` requires a GPIB analyzer and can be omitted if an analyzer is not available.

Complete the following steps to verify the software installation:

1. Run `ibtsta` by entering the following command:

   ```
   ibtsta
   ```

2. If `ibtsta` completes with no errors and a bus analyzer is available, connect the bus analyzer to the GPIB board, then run `ibtstb` by entering the following command:

   ```
   ibtstb
   ```

   If no error occurs, the NI-488.2M driver is installed correctly.

Troubleshooting Error Messages

If `ibtsta` fails, the program generates common error messages that appear on your screen. These error messages explain what went wrong when you ran `ibtsta` and describe how you can correct the errors. For example, the following message might appear on your screen if you forgot to disconnect all your GPIB cables:

```
The fact that the ENOL error was not received when expected
indicates the possible presence of other devices on the bus.

Please disconnect ALL GPIB cables from the GPIB board,
then run this test again.
```

If you are still unable to run `ibtsta` and/or `ibtstb` successfully after you have followed the suggestions provided by the error messages, fill out the forms in Appendix B, *Customer Communication*, and contact National Instruments for assistance.

Chapter 5
Using Your NI-488.2M Software

This chapter describes the `ibic` utility and lists some programming considerations.

Introduction to ibic

The Interface Bus Interactive Control utility, `ibic`, comes with your NI-488.2M software. You can use `ibic` to enter NI-488.2 functions interactively and to display the results of the function calls automatically. Without writing an application, you can use `ibic` to do the following:

•   Verify GPIB communication with your device quickly and easily.

•   Learn the usage of the NI-488 functions and NI-488.2 routines before you write your application.

•   Become familiar with the commands of your device.

•   Receive data from your GPIB device.

•   Troubleshoot problems with your application.

For more information about `ibic`, refer to Chapter 6, *ibic*, in the *NI-488.2M Software Reference Manual*.

Programming Considerations

When you have installed the NI-488.2M driver and successfully verified its installation, you are ready to proceed with the development of your NI-488.2M application software.

As you begin developing your NI-488.2M application, consider the following:

•   Your application program must include the following header file:

     `<sys/ugpib.h>`.

•   The file `cib.c` is the interface between your C language application program and the operating system entry points to the NI-488.2M driver. The NI-488 functions and NI-488.2 routines available in `cib.c` are described briefly in Chapter 3, *Understanding the NI-488.2M Software*, in the *NI-488.2M Software Reference Manual*. The NI-488 functions and NI-488.2 routines are described in more detail in

Chapter 4, *NI-488.2M Software Characteristics and Routines*, and in Chapter 5, *NI-488M Software Characteristics and Functions*, in the *NI-488.2M Software Reference Manual*. To use the NI-488 functions and NI-488.2 routines, you must compile `cib.c` and include the resulting object file (`cib.o`) during the link phase each time you compile your application, as shown in the example below:

```
cc my_appl.c cib.o
```

Alternatively, you can compile your application and link it to the C language library, `libgpib.a` (created when you installed the software), as shown in the example below:

```
cc my_appl.c -lgpib
```

- For more information on creating the C language library `libgpib.a`, refer to Chapter 3 of this manual.

- For information about choosing a programming method, developing your application, or compiling and linking, refer to the *NI-488.2M Software Reference Manual*. The software reference manual contains detailed information about each NI-488 function and NI-488.2 routine.

Appendix A
Hardware Specifications

This appendix describes the physical characteristics of the AT-GPIB/TNT board and the AT-GPIB board and the recommended operating conditions of the boards.

Table A-1. Electrical Characteristics for the AT-GPIB/TNT board

Characteristic	Specification
Maximum GPIB Transfer Rates:	
3-wire (IEEE 488)	1.4 MB/s*
High Speed (HS488):	
In ISA computer	1.6 MB/s*
In EISA computer	3.4 MB/s*
Power Requirement (from PC AT I/O channel)	+5 VDC 50 mA Typical 100 mA Maximum
* Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.	

Table A-2. Electrical Characteristics for the AT-GPIB board

Characteristic	Specification
Maximum GPIB Transfer Rates:	
Reads	1.3 MB/s*
Writes	1.3 MB/s*
Power Requirement (from PC AT I/O channel)	+5 VDC .66 A Typical 1.50 A Maximum
* Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.	

Table A-3. Physical Characteristics

Characteristic	Specification
Dimensions	10.67 cm by 16.51 cm (4.2 in. by 6.5 in.)
I/O Connector	IEEE 488 Standard 24-pin

Table A-4. Environmental Characteristics

Characteristic	Specification

Operating Environment:
 	
  Component Temperature
  Relative Humidity
	
	0° to 40° C
	10% to 90%, noncondensing

Storage Environment:
 	
  Temperature
  Relative Humidity
	
	-20° to 70° C
	5% to 90%, noncondensing

EMI	FCC Class B Certified

Appendix B
Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

Corporate Headquarters
(512) 795-8248
Technical support fax: (800) 328-2203
                           (512) 794-5678

Branch Offices	Phone Number	Fax Number
Australia	(03) 879 9422	(03) 879 9179
Austria	(0662) 435986	(0662) 437010-19
Belgium	02/757.00.20	02/757.03.11
Denmark	45 76 26 00	45 76 71 11
Finland	(90) 527 2321	(90) 502 2930
France	(1) 48 14 24 00	(1) 48 14 24 14
Germany	089/741 31 30	089/714 60 35
Italy	02/48301892	02/48301915
Japan	(03) 3788-1921	(03) 3788-1923
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Spain	(91) 640 0085	(91) 640 0533
Sweden	08-730 49 70	08-730 43 70
Switzerland	056/20 51 51	056/20 51 55
U.K.	0635 523545	0635 523154

Technical Support Form

Technical support is available at any time by fax. Include the information from your configuration form. Use additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax   (____)_____   Phone   (____)_____

Computer brand _____

    Model _____   Processor _____

    Operating system _____

    Speed _____MHz   RAM _____MB

    Display adapter _____

    Mouse _____yes   _____no

    Other adapters installed _____

    Hard disk capacity _____MB   Brand _____

    Instruments used _____

National Instruments hardware product model _____

    Revision _____

    Configuration _____

National Instruments software product _____

    Version _____

    Configuration _____

(continues)

The problem is _____

_____

_____

_____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

_____

_____

_____

_____

GPIB Board Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Update this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration.

National Instruments Products

- GPIB Board and Revision Number

    – AT-GPIB/TNT Board Revision _____

    or

    – AT-GPIB Board Revision _____

- NI-488.2M Software Revision Number on Distribution medium

    _____

- Shield Ground _____

- Board Settings

	Base I/O Address	Interrupt Level	DMA Channel
gpib0	_____	_____	_____
gpib1	_____	_____	_____
gpib2	_____	_____	_____
gpib3	_____	_____	_____

Other Products

- Computer Make and Model _____

- Microprocessor _____

- Clock Frequency _____

- Type of Monitor Card Installed _____

- HP-UX Platform _____

- Application Programming Language (BASIC, C, Pascal, and so on) _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: **Getting Started with Your AT-GPIB/TNT and the NI-488.2M™ Software for HP 9000 Series 700**

Edition Date: **July 1994**

Part Number: **320634A-01**

Please comment on the completeness, clarity, and organization of the manual.

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(continues)

If you find errors in the manual, please record the page numbers and describe the errors.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Thank you for your help.

Name   _____

Title   _____

Company   _____

Address   _____

            _____

Phone   (_____)   _____

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              National Instruments Corporation
              6504 Bridge Point Parkway, MS 53-02
              Austin, TX 78730-5039

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              National Instruments Corporation
              MS 53-02
              (512) 794-5678

Glossary

Prefix	Meaning	Value
m- c- k- M-	milli- centi- kilo- mega-	10^{-3} 10^{-2} 10^{3} 10^{6}

°	degrees
%	percent
A	amperes
ASIC	application-specific integrated circuit
C	Celsius
CPU	central processing unit
DACK	DMA Acknowledge line
DMA	direct memory access
DRQ	DMA Request line
EISA	Extended Industry Standard Architecture
EMI	electromagnetic interference
FCC	Federal Communications Commission
GPIB	General Purpose Interface Bus
hex	hexadecimal
I/O	input/output
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
IRQ	interrupt request line
ISA	Industry Standard Architecture
m	meters
MB	megabytes of memory
PC	personal computer
s	seconds
VDC	volts direct current